

## CLAIMS

- 1    1. A method for distributing parity across a disk array, the method comprising the steps  
2    of:  
3        adding a new disk to pre-existing disks of the array;  
4        dividing each disk into blocks, the blocks being organized into stripes such that  
5    each stripe contains one block from each disk; and  
6        distributing parity among blocks of the new and pre-existing disks without recal-  
7    culation or moving of any blocks containing data.
- 1    2. The method of Claim 1 wherein the step of distributing comprises the step of distrib-  
2    uting parity among blocks of the new and pre-existing disks in a manner that maintains a  
3    fixed pattern of parity blocks among stripes of the disks.
- 1    3. The method of Claim 1 wherein the step of distributing comprises the step of changing  
2    an assignment for one or more blocks containing parity of each pre-existing disk to the  
3    newly added disk.
- 1    4. The method of Claim 2 wherein the step of adding comprises the step of initializing  
2    the added disk so as to not affect parity of the stripes.
- 1    5. The method of Claim 4 wherein the step of initializing comprises the step of reas-  
2    signing blocks containing parity in certain stripes to the new disk without calculation or  
3    writing of parity.
- 1    6. The method of Claim 5 wherein the certain stripes comprise  $1/N$  of the stripes, where  
2     $N$  is equal to the number of disks in the array.

- 1    7. The method of Claim 5 wherein the step of reassigning comprises the step of chang-  
2    ing a block containing parity (parity block) to a block containing data (data block) and  
3    not changing a data block to a parity block.
- 1    8. The method of Claim 1 wherein the step of distributing comprises the step of reas-  
2    signing one of N blocks containing parity (parity blocks) from each pre-existing disk to  
3    the added disk, wherein N is equal to the number of disks in the array.
- 1    9. The method of Claim 8 wherein the step of reassigning comprises the step of reas-  
2    signing one of N parity blocks to the new disk, with each pre-existing disk continuing to  
3    hold 1/N of the parity blocks in the array.
- 1    10. A system adapted to distribute parity across disks of a storage system, the system  
2    comprising:  
3        a disk array comprising pre-existing disks and at least one new disk; and  
4        a storage module configured to compute parity in blocks of stripes across the  
5    disks and reconstruct blocks of disks lost as a result of failure, the storage module further  
6    configured to assign the parity among the blocks of the new and pre-existing disks with-  
7    out recalculation or moving of any data blocks.
- 1    11. The system of Claim 10 further comprising a table configured to store parity assign-  
2    ments calculated for one of a known group size of the disk array and a maximum group  
3    size of the array, the stored parity assignments defining a repeat interval of a parity distri-  
4    bution pattern used to determine locations of parity storage on any disk in the array.
- 1    12. The system of Claim 10 wherein the storage module is embodied as a RAID system  
2    of the storage system.

- 1 13. The system of Claim 10 wherein the storage module is embodied as an internal disk  
2 array controller of the storage system.
- 1 14. The system of Claim 10 wherein the storage module is embodied as a disk array  
2 control system externally coupled to the storage system.
- 1 15. The system of Claim 10 wherein the disk array is a block-based RAID array.
- 1 16. A method for distributing commodities over containers of a system, the method  
2 comprising the steps of:  
3 adding a new container to pre-existing containers of the system to thereby provide  
4 N containers; and  
5 moving only  $1/N$  of the commodities to the new container.
- 1 17. The method of Claim 16 wherein the system is a storage system, the commodities are  
2 data structures adapted for storage on storage devices of an array, and the containers are  
3 storage entities coupled to the array.
- 1 18. The method of Claim 17 wherein the storage entities are storage heads.
- 1 19. The method of Claim 17 wherein the data structures are inode file blocks.
- 1 20. Apparatus for distributing parity across a disk array, the apparatus comprising:  
2 means for adding a new disk to pre-existing disks of the array;  
3 means for dividing each disk into blocks, the blocks being organized into stripes  
4 such that each stripe contains one block from each disk; and  
5 means for distributing parity among blocks of the new and pre-existing disks  
6 without recalculation or moving of any blocks containing data.

- 1 21. A computer readable medium containing executable program instructions for distrib-
- 2 uting parity across a disk array, the executable instructions comprising one or more pro-
- 3 gram instructions for:
  - 4 adding a new disk to pre-existing disks of the array;
  - 5 dividing each disk into blocks, the blocks being organized into stripes such that
  - 6 each stripe contains one block from each disk; and
  - 7 distributing parity among blocks of the new and pre-existing disks without recal-
  - 8 culation or moving of any blocks containing data.